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Status of Atlantic salmon in the Morell, Mill, Dunk, West, and Valleyfield Rivers, Prince Edward Island, in 1994

by

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Research documents are produced in the official language in which they are provided to the secretariat.

[1]La présente série documente les bases scientifiques des évaluations des ressources halieutiques sur la côte Atlantique du Canada. Elle traite des problèmes courants selon les échéanciers dictés. Les documents qu'elle contient ne doivent pas être considérés comme des énoncés définitifs sur les sujets traités, mais plotôt comme des rapports d'étape sur les études en cours.

Les documents de recherche sont publiés dans la langue officielle utilisée dans le manuscrit envoyé au secrétariat.

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Abstract

Salmon were historically abundant in Prince Edward Island, but were eliminated from most streams following colonization. Since the mid-1980s enhancement and stocking efforts have re-established salmon runs on several PEI rivers, particularly the Morell. Targets based on 2.4 eggs m^{-2} of river area are 537 large salmon and 288 small salmon for the five most important salmon streams on PEI, including 159 large salmon and 85 small salmon for the Morell. Most salmon stocked on PEI are reared semi-naturally in open impoundments and released as 2+ smolts. In 1993, 2+ smolts were not released into the Morell because of a fish die-off in the rearing pond during the previous year. In their place, 2200 1+ parr were released in fall 1992 and 19,379 growth-accelerated 1+ smolts were released in spring 1993.

A creel survey of angler catch and effort on the Morell estimated that 302 black salmon were caught and released in April 1994. No small salmon retentions were reported during the creel survey, but a telephone canvas of anglers indicated a retained catch of about 40 small salmon.

Densities of juvenile salmon, measured by electrofishing at six sites in late summers 1984, 1985, and 1994, were used to generate population estimates of 22,976 0+ parr and 11,198 1+ parr for the Morell.

Numbers of salmon ascending the fishway at Leard's Pond on the Morell in 1994 were the lowest since the mid-1980s, and estimated egg deposition by fish released above this site was only 10% of target. This sharp drop is likely related to the lack of stocking in 1993 of 2+ smolts.

Given 1+ parr numbers estimated from electrofishing, and assuming 50% overwinter survival, a 2% return rate from sea and that 85% of returning fish do so after one sea winter, 95 small and 17 large wild salmon should return to the Morell in 1995. With similar assumptions, 464 small hatchery salmon should return in 1995. These projections are based on uncertain assumptions and are subject to wide error. Numbers of large hatchery salmon cannot be predicted because there is no basis for foretelling the return rate of fish released as 1+ smolts in spring 1993.

Resumé

Le saumon était autrefois abondant à l'Ile de Prince Edouard, mais il était éliminé de la plupart des ruisseaux suite à la colonisation européenne. Depuis le milieu des années 1980, l'amélioration de l'habitat et le stockage ont rétabli le saumon dans quelques rivières de l'IPE, notamment la Morell. Les cibles, basées sur 2.4 oeufs m^{-2} de superficie de rivière, sont 537 gros saumons et 288 petits saumons pour les cinq rivières principales de l'Île. Ceci inclut 159 gros saumons et 85 petits saumons pour le Morell. La plupart des saumons placés dans les rivières de l'IPE sont élevée de façon semi-naturelle dans les réservoirs, et ils sont relâchés au stade saumoneau à l'âge de 2+ ans. En 1993, à cause d'une mortalité dans l'étang d'élevage l'année précédente, aucun saumoneau âgé de 2+ ans n'était relâché dans la Morell.

Un relevé des pêcheurs mené sur la Morell a estimé des prises relâchées de 302 saumons noirs en avril 1994. Les pêcheurs interviewés dans ce relevé n'ont rapporté aucun petit saumon dans leurs prises retenues, mais un relevé téléphonique informel a indiqué une prise retenue d'à peu près 40 poissons.

Les densités des tacons, mesurées par la pêche électrique à six sites vers la fin des étés de 1984, 1985 et 1994, ont servi pour générer les estimés de 22,976 tacons âgés de 0+ ans et de 11,198 tacons âgés de 1+ ans dans la Morell.

Les saumons qui ont monté l'échelle aux poissons à Leard's Pond en 1994 étaient le moins nombreux depuis le milieux des années 1980, et la déposition des oeufs en 1994 n'était que 10% de la cible. La vraisemblable cause de cette chute est le manque de stockage des saumoneaux de 2+ ans en printemps 1993.

Avec les populations estimées par la pêche électrique, et en présumant une survie hivernale de 50%, un taux de retour de la mer de 2%, et que 85% des poissons qui reviennent le font après un an en mer, on prédit que 95 petits saumons sauvages et 17 gros saumons sauvages devraient retourner à la Morell en 1995. Le même genre de calcul mène à une prévision d'un retour de 464 petits saumons nés en éclosérie en 1995. Ces prévisions reposent sur les présumptions incertaines et elles ont une très large marge d'erreur. On ne peut pas prédire le nombre de gros saumons qui reviendront en 1995 parce qu'on ne sait pas le taux de retour des saumoneaux relâchés à l'âge de 1+ an en printemps 1993.

Introduction

Because of its insular status, Prince Edward Island has a low diversity of freshwater fishes, and native game fish are limited to brook trout and Atlantic salmon. Early accounts indicated an abundance of salmon in the Island's short, barrier-free rivers, with fish arriving on the north shore in June and July and on the south shore in September and October (Dunfield 1985). A substantial commercial salmon fishery developed during the first half of the 18th century, with the greatest activity focused on the St. Peters Bay area.

Despite the imposition of fishing restrictions as early as 1780, salmon declined rapidly and were eliminated from many rivers early in the 19th century (Dunfield 1985). Nevertheless a commercial fishery persisted. Some 10.5 tonnes of salmon were exported in 1865, and 727 kg were taken from the St. Peters Bay area in 1893 (Table 1). In the 20th century the salmon resource declined further, and by the mid-1970s few or no fish were being taken on the Morell River, which is the largest river of St. Peter's Bay (Table 2, Figs. 1-3).

At the present time, brook trout are universal in PEI streams, but salmon are commonly found in only a few of the larger rivers. Rainbow trout have been widely introduced, and have taken hold in a few places.

In the early 1980s concerted efforts were launched to restore the Atlantic salmon populations of PEI rivers. Through the combined efforts of federal and provincial agencies and volunteer groups, enhancement programs were initiated on the Mill and Morell Rivers (Bielak et al. 1991; Figs. 1 and 2). These programs included habitat improvement, selective breeding of early-run genetic stocks, and the development of semi-natural pond rearing of smolts. The semi-natural rearing facility at Profit's Pond on the Mill River watershed began rearing salmon in 1985, and the Mooney's Pond facility on the Morell began operations in 1989. At both sites, volunteer groups (the O'Leary Wildlife Federation, the Morell River Management Co-op) raised fish furnished by the Cardigan Salmonid Enhancement Centre of the Department of Fisheries and Oceans. These enhancement effort were successful in the Morell River, and by the late 1980s several hundred salmon were taken annually in that river.

Habitat enhancement and stocking efforts have also been directed at the Valleyfield, Dunk, and West Rivers, and in 1994 a new semi-natural rearing facility at Gilbert's Pond in Montague was set up. The initiation of a joint federal-provincial Watershed Improvement/ Recreational Fisheries Development Program has provided resources for the expansion of Atlantic salmon and brook trout enhancement in Prince Edward Island rivers.

The Morell River, in east-central PEI, drains an area of 171 km^2. This document gives an update of the Atlantic salmon resource in the Morell, which remains the most important stream for Atlantic salmon on PEI. It also reports stocking and monitoring efforts in the West, Dunk, Mill, and Valleyfield Rivers. Throughout the paper adult salmon under 63 cm in fork length are referred to as "small salmon" and fish over this length are called "large salmon." Most fish classified as small salmon have spent one winter at sea and most fish classified as large salmon have spent two or more winters at sea.

Bielak et al. (1991), Davidson and Bielak (1992) and Davidson and Angus (1994) provided previous reports on the status of PEI salmon stocks.

Description of Fisheries

In most waters the 1994 open season for Atlantic salmon was 15 June - 15 September, but other open seasons applied in some rivers. In the Morell River, salmon fishing opened on 1 June and continued to 14 October at most sites (Table 3). In the main branch from MacKay's to the Forks (Fig. 2) the salmon season closed on 31 October, and in Leard's Pond it concluded on 30 November. The extension of salmon fishing to 31 October also applied to the Valleyfield River below MacRae's dam, the West River below Rte. 249, the Dunk River below Scales' Pond, and the Mill River below Route 148.

The daily bag limit was one small salmon and the season limit was seven. Retention of large salmon was not permitted.

Residents of Prince Edward Island between the ages of 16 and 64 who are not farmers, commercial fishermen, or aboriginals were required to purchase a licence in order to fish trout on PEI in 1994. Residents over 65 required a courtesy licence which was issued free. Non-residents required a non-resident trout licence. To fish salmon, an angler required both a salmon licence and the appropriate trout licence.

The number of angling licences sold on PEI in 1994 is as follows:

Resident trout	8,627
Courtesy resident trout (over 65)	1,450
Non-resident trout	967
Total trout	11,044
Salmon	577

The Department of Fisheries and Oceans and the PEI Native Council concluded an agreement providing for a native allocation of 400 adult Atlantic salmon from the Morell River in 1994.

There are anecdotal reports of salmon caught as bycatch in mackerel nets as they migrate along the Prince Edward Island shoreline. The extent of this harvest is unknown, nor is it known whether these fish are destined for PEI rivers or those of other provinces.

Target

Targets for Prince Edward Island salmon are set as numbers of spawning adults required to utilize available habitat. It is assumed that populations attain this target if egg deposition by spawning adults equals or surpasses 2.4 eggs per m^2 of non-tidal, non-impounded river area.

Fecundities and sex ratios of Morell salmon are given in Tables 4-5. River areas for the Mill, Dunk, West, Morell, and Valleyfield Rivers are derived from habitat surveys in which the width of the wetted area was measured in cross-stream transects (Davidson and Angus 1994, Tables 6-9). The Morell contains 237,176 m^2, of which 74,727 m^2 (32%) is upstream from Leard's Pond.

Spawning requirements are calculated in Table 10 according to the method below (Morell River data are used as an example). Note that some figures do not sum exactly because of rounding.

i) Number of eggs required for the river = river area x 2.4 eggs /m^2. [237,176 x 2.4 = 569,222]

ii) Number of large females required to produce these eggs = number of eggs/fecundity. It is assumed that all eggs come from large females. This assumption is justified because large females produce far more eggs than small females, and because most small salmon are males. [569,222/4963 = 115].

iii) Number of large males required = number of large females x (100 - percent of large salmon that are female)/percent of large salmon that are female. This gives the number of large males that would accompany the required number of large females, given the sex ratio measured in previous years. [115 x (100 - 72.1)/72.1 = 44].

iv) Total number of large salmon required = number of large female salmon required + number of large male salmon required. [115 + 44 = 159].

v) Male deficit = number of large females required - number of large males required. This gives the number of additional males required to provide each spawning female with a mate. [115 - 44 = 70].

vi) Total number of small salmon required, if small salmon meet the male deficit = 100 x male deficit/percent of small salmon that are male. [100 x 70/82.5 = 85].

The Morell requirements were estimated at 159 large salmon and 85 small salmon, including 50 large and 27 small salmon above Leard's Pond. Total requirements for the five rivers are 537 large salmon and 288 small salmon.

In addition to the Morell's natural spawning needs, there is a requirement for 20 large salmon and 50 small salmon for use as broodstock at the Cardigan Salmonid Enhancement Centre. These fish are collected from the trap at Leard's Pond.

Fisheries data

Stocking

Most salmon stocked on PEI are cultured through a process known as semi-natural rearing. Fish are hatched at the Cardigan Salmonid Enhancement Centre, and are placed in Mooney's, Profitt's, or Gilbert's Ponds in the spring following their year of hatching. These are artificial impoundments which have barriers at their inlets and outlets to prevent fish from escaping. The fish are fed artificial food in these ponds, but they are exposed to natural mammalian and avian predation. Natural food is also available in these ponds. At the age of 2 years, these fish are released into streams as 2+ smolts. At Profitt's Pond, the smolts are collected by lowering the pond level and concentrating the fish with seines. At Mooney's, the fish are collected by lowering the pond and waiting for the fish to enter the pond's outlet where they are trapped. Fish from both ponds are trucked in tanks to their release sites. Some fish at Mooney's are released directly from the pond into the river.

Numbers of juvenile salmon stocked in major PEI streams are given in Tables 11 and 12. In the summer of 1992, young salmon in Mooney's Pond were subject to a die-off due to unidentified causes. About 2200 fish which survived the die-off were released from Mooney's Pond directly into the west branch of the Morell River.

The fish which died would normally have been released as 2+ smolts in spring 1993. To replace them, the Cardigan Salmonid Enhancement Centre accelerated the growth of tank-held salmon by heating water and providing extra rations. In spring 1993 19,379 of these fish were released into the Morell as 1+ smolts.

In 1994 the normal stocking pattern resumed and about 26,000 2+ salmon, mostly smolts, were released into the Morell. The West, Dunk, Valleyfield, and Mill Rivers each received several thousand 1+ and 2+ salmon, and 20,000 0+ parr (fall fingerlings) were placed in each of the Valleyfield and Midgell Rivers.

Morell creel census

A bus-stop creel census (Jones and Robson 1991) was conducted on the Morell River in 1994. In this survey the clerk traveled in a circuit to the principal angling sites on the river, stopping at each a pre-determined amount of time to interview anglers who had concluded their fishing trips and were exiting the river. Clerks asked exiting anglers how many fish they caught and of what type, the duration of their fishing trip, and what species they were targeting.

Surveys were organized in time blocks A (dawn to 10:00), B (10:00 to 14:00), C (14:00 to 18:00), and D (18:00 to the end of fishing) (all times ADT). Surveys of the D block were extended up to 1.5 hours after sunset to ensure that late-returning anglers were not missed.

The survey design entailed three levels of randomization. First, the start point on the survey circuit was randomly chosen. Second, within each survey day two of the four time blocks were randomly chosen (except for April 15-17 and 1-30 November, see below). Third, days on which surveys were conducted were randomly chosen. This entailed a random selection of days with the weekday period (Monday-Friday) and within the weekend period (Saturday-Sunday). For survey purposes public holidays were considered as weekend days.

The trout fishing season opened on Friday, 15 April. On this and the following two days, two clerks were employed from dawn to the end of fishing on each day. One clerk's circuit included only the Morell and Anderson sites (Fig. 2), and the other clerk's circuit included all other sites. For most of the spring and summer fishing season, one clerk worked both weekend days and either two or three days during weekdays. During November, when fishing was allowed only at Leard's Pond, the clerk worked one time block per weekend and one time block per weekday period.

A preliminary analysis of survey results is presented in Table 13. Effort and catches were calculated per "cell" which is a particular time block in a particular day type (weekend or weekday) in a particular month at a particular station. Months are here considered as 15-17 April (opening weekend), 18-30 April, May, June, . . . November. Where data were absent for a cell, substitute data were used according the following priorities: where block A was missing, block B was substituted; where block D was missing, block C was substituted; where block B or C was missing, block B or C was substituted; where data were missing for a day, data for the nearest day at the same station were substituted.

Total catch for each cell was the product of mean number of angler exits per hour, mean duration of fishing sessions, mean fish caught per hour, and the number of fishing hours available in the cell.

Anglers were estimated to have spent 32,290 hours fishing during 10,937 sessions in the Morell in 1994 (Table 13). The principal catch was brook trout, of which an

estimated 1805 were caught and retained and 2948 were caught and released. In April, an estimated 302 black salmon were caught and released by anglers. No small salmon were reported during creel interviews during the remainder of the season. In August and September, an estimated 155 large salmon were caught and released.

No angler reported catching and retaining small salmon during creel interviews; hence the creel census yielded an estimate of zero retained catch. However, informal reports from anglers indicated that some small salmon were caught and retained. A canvas of anglers who frequent the river and of local knowledgeable individuals (former creel clerks, members of the Morell River Management Co-op, a conservation officer) was therefore conducted to provide an estimate of retained catch. Telephone interviews in January 1995 obtained the retained catches of 22 anglers. In seven cases the information was obtained directly from the angler, and in 15 cases the information was obtained from a third party. It is thought that the anglers whose catches were obtained in this way included most of the regular salmon anglers on the river.

This informal survey indicated 30 small salmon caught and retained on the Morell in 1994. Five of these were from Leard's Pond. It seems reasonable to estimate that about 40 small salmon were caught and retained on the Morell in 1994, including about 7 from Leard's Pond.

Two hundred and nine anglers told creel clerks what species they were targeting during interviews between 1 June and 30 November, the salmon season on the Morell. Of these 31 (14.8%) said they were targeting trout, 53 (25.4%) said they were targeting salmon, and 125 (59.8%) said they were targeting both.

The creel census estimated 5766 angler exits from the principal fishing sites on the Morell during the salmon season. Anglers targeting salmon and anglers targeting both trout and salmon together accounted for 178 (85.2%) of those reporting their target species. Applying this percentage to the exit total yields an estimated total of 4911 exits by anglers whose target species included salmon. Since some anglers may fish at more than one site in a given day, this can be considered a minimum estimate for salmon rod-days.

Native fishing diaries

The Prince Edward Island Native Council, which represents off-reserve Micmacs, required people under its jurisdiction to fill in daily summaries of their fishing activities in 1994. Four anglers returned cards, reporting fishing activities in April, May, and June. In 39.5 reported fishing hours these anglers caught 66 brook trout and nine rainbow trout, for an overall catch rate of 1.90 fish per hour. No salmon were reported to have been caught. No salmon were caught from the 400 Morell salmon allotted to the Native Council.

Research data

Fish movements

Upstream movements of Atlantic salmon have been monitored at the Leard's Pond fishway since 1981 (Table 14, Figs. 4-5). There are indications that some salmon may have ascended to Leard's Pond in 1994 without passing through the fishway (see below), so the movement numbers cannot be considered complete. Numbers of small salmon (36) passing though the fishway were the lowest since 1985, and the percentage of wild (non-hatchery) fish was the highest in the time series. The low number of hatchery-reared fish is presumably related to the die-off in Mooney's Pond semi-natural rearing facility in 1992 which prevented the normal stocking of 2+ smolts in spring 1993. The 2200 1+ parr released in fall 1992 and the 19,379 accelerated 1+ smolts released in spring 1993 apparently failed to make up for the absence of 2+ stocking in spring 1993. In contrast, the number of ascending large salmon (29) was closer to a normal value.

The Morell salmon stock includes both early and late run fish, but early run fish are numerically dominant (Figs. 6-7). In 1994 both early and late run fish were also present, with hatchery salmon most numerous in the early run and wild salmon dominating the late run.

Because the Leard's fishway is near the headwaters of the system, many salmon that enter the river will not traverse it. Hence a fish fence was erected at Bangor in June 1994 to intercept ascending salmon near the head of tide (Fig. 2). This fence consisted of electrical conduit set in steel rails, with a conduit in every second hole in order to pass trout and other species. The initial design of a partial fence failed to catch salmon, so the fence was subject to repeated modifications and extensions. By 1 October it had been extended completely across the river. Nine salmon were captured and released upstream in October 1994 as follows: two wild large females; two wild small salmon, sex unknown; one large salmon, sex and origin unknown; one large hatchery female; two large hatchery fish, sex unknown; and one small hatchery male. There was only one re-capture from these tagged fish. A large hatchery-reared female was tagged on 23 October and recovered the following day at Leard's fishway.

Movements of trout and salmon at other major streams are presented in Table 15. In general, 1994 was a year of low salmon returns in these streams. Low water levels across Prince Edward Island may have helped depress runs. For the West, the drop in returns from the previous year may be related to the absence of stocking of 2+ smolts in this stream in 1993.

Electrofishing surveys

Electrofishing surveys were conducted in late summer and early winter 1994 to measure changes in salmonid densities since 1984 and 1985. The surveys involved multiple sweeps (usually four) within stream sections that were bounded by barrier nets. Survey sites (Fig. 2, Appendix 1) were in the same general areas as those used by Ducharme (1977).

Densities of juvenile Atlantic salmon in August-September 1994 ranged from 3.3 to 139.4 fish per 100 m^2, with numbers generally increasing towards the headwaters (Table 16). Single-sweep surveys at the same sites in December showed the same tendency. A sample of 27 0+ parr taken in December revealed 14 non-precocious males and 13 females. One precocious 1+ male was noted at Mooney's Bridge in December. Late summer numbers were higher in 1994 than the 1980s for the Forks and above, but the reverse was true below the Forks.

Electrofishing densities and river area measurements (Table 10) were used to estimate total populations of juvenile Atlantic salmon in the Morell. This analysis yielded estimates of 35,995 0+ salmon and 15,633 1+ salmon in the Morell in late summer 1994 (Table 17). Late summer populations of

wild-reared fish averaged for 1984, 1985, and 1994, were 22,976 0+ fish and 11,198 1+ fish.

Redd surveys

Counts of salmon redds in the Mill, Dunk, and Morell Rivers are presented in Table 18. Counts in the Mill declined from 311 to 144 between 1993 and 1994. In 1994, 162 salmon redds were counted in the Morell. This number is much lower than those of the previous four years (362-917). Sixty two of the 162 (38%) salmon redds reported in the Morell in 1994 were above Leard's dam. Redd-counters saw Atlantic salmon at about a dozen of these redds during their counts (D.L. Guignion pers. comm.) In 1990, 55% of redds reported for the Morell were above Leard's, and in 1991 46% were above Leard's.

Estimation of stock parameters

Counts of fish ascending the fishway at Leard's Pond are the central tool in assessing Morell River salmon stocks. This site is high on the watershed and only 32% of the Morell's river area is upstream from it. Hence counts at Leard's are an index of run size, not a total count. Since the proportion of fish entering the river that pass Leard's is not known, it is not possible to estimate total run size for the river.

Assessment results

The low counts of ascending fish at Leard's suggested that the 1994 Morell salmon run was the weakest since the mid 1980s. The estimate of 40 retained small salmon from the angler canvas is the lowest retained catch since the mid-1980s (disregarding 1993 for which no data are available).

Based on records of fish released above Leard's, egg deposition above Leard's was only 10% of target (Table 19). This is the first time since 1986 that calculated deposition fell below target. In 1994 only 3 large and 2 small salmon were released into the pond, as the other ascending fish were required for broodstock purposes at the Cardigan Salmonid Enhancement Centre. This suggests that only a very small number of eggs would be deposited above Leard's in fall 1994. However, two lines of evidence suggest that many fish are reaching Leard's Pond without being counted. First, 62 salmon redds were reported from above Leard's in fall 1994 (Table 18). Fifty male small salmon were released above Leard's on 31 October 1994, but these fish cannot explain the high redd numbers because redd construction is initiated by female Atlantic salmon (Scott and Crossman 1973). Second, the angler canvas reported five small salmon being caught and retained in Leard's Pond in 1994, whereas only two small salmon were released into the pond (Table 19).

At-sea survival for stocked Morell salmon can be estimated for fish stocked above Leard's by dividing the sum of returns to Leard's and estimated sport catch by the number of fish stocked above Leard's (Table 20). This analysis must be considered approximate because not all fish stocked above Leard's will spawn above Leard's.

Since it is not known when the bulk of the 1+ smolts released in 1993 will return, their survival rate cannot be calculated at present. The low numbers of small salmon returning in 1994 suggest that these fish either deferred their return until 1995, or suffered high mortality after their release.

Salmon returns to the West, the Mill, and the Valleyfield Rivers declined from 1993 to 1994 (Table 15). The low returns in the West and the Valleyfield may be related to the lack of stocking 2+ smolts in these rivers in spring 1993. Salmon returns to each of these rivers is much below the river's spawning requirement. No movement data are available for the Dunk for 1994.

Ecological considerations

The Morell River is a low gradient stream with 11 impoundments in its headwaters. These factors combine to make the Morell vulnerable to high water temperatures, especially in warm dry summers such as 1994. Excessive temperature may thus be considered as the major ecological concern faced by Morell salmonids.

Trout are more sensitive to high temperatures than salmon, and their absence from the Leard's Bridge electrofishing site in late August may be due to temperatures in the mid-20s that had prevailed until a few days prior to the survey. The extent to which high summer temperatures cause problems for Morell salmon is unclear, but potentially substantial. Ducks Unlimited, in collaboration with the PEI Fish and Wildlife Division, will be drawing down some of its headwater impoundments in 1995-1997 on a rotating basis. This may reduce some of the high water temperatures in the river.

Forecasts/prospects

The Morell salmon run consists of wild and hatchery-reared fish, with both small and large salmon being present in both categories. The stockings which are the principal potential contributors to the 1995 salmon run are the release of 1+ smolts in spring 1993, and of 2+ smolts in spring 1994 (Table 11). In 1993 19,379 1+ fish were released, but numbers of the 1994 release are not exactly known because some fish were not counted and some escaped. It seems likely that about 26,000 2+ smolts were released in spring 1994.

Sea survival rates of salmon released as 2+ smolts cannot be predicted with certainty because some fish that were released above Leard's might return to spawn downstream from Leard's where they would not be enumerated (see above), and sea survival varies from year to year. A 2% return rate is a conservative estimate. Since the bulk of salmon stocked in the Morell have been 2+ smolts, it is not possible to calculate sea survival of fish released at other stages.

Of 6,140 hatchery fish that ascended Leard's in 1981-1994, 451 (7.3%) were large (Table 14). Of 269 wild fish that ascended Leard's during this period, 41 (15.2%) were large. Assuming that small salmon spend one winter at sea, expected returns from the 1994 stocking of 2+ smolts are number released x sea survival x proportion returning as small salmon:

25,000 x 0.02 x (1-0.073) = 463.5 hatchery small salmon.

Given the absence of information on sea survival rate of salmon released as 1+ smolts, it is not possible to predict returns of large hatchery-reared salmon in 1995.

Returns of naturally reared salmon in 1995 will come chiefly from the 1994 spring smolt exodus (small salmon) and the 1993 spring smolt exodus (large salmon). No data are available on juvenile densities of fish from these cohorts. The best estimate of these juvenile densities is likely the mean of densities obtained in 1984, 1985, and 1994. The total number of wild-reared 1+ salmon in the Morell, meaned from estimates derived from electrofishing measurements in late

summer 1984, 1985, and 1994, is 11,198. If numbers of juveniles which will contribute to the 1995 run were similar to this mean, and overwinter survival is 50%, the naturally-reared 1995 run of small salmon can be predicted as = number of 1+ juveniles in late fall x overwinter survival x sea survival x proportion of small salmon:

11,198 x 0.5 x 0.02 x (1-0.152) = 95.0 wild small salmon.

The calculation for wild large salmon is:

11,198 x 0.5 x 0.02 x 0.152 = 17.0 wild large salmon.

Thus the 1995 Morell small salmon run can be predicted as (463.5+95.0) = 558.5 fish. The large salmon run should have 17 wild fish plus an unknown number of hatchery fish.

If the predictions are correct, returning small salmon ought to meet the spawning requirement of 66 fish (Table 10), even if the exploitation rate is heavy. However, it is not possible to predict whether the overall spawning requirement will be met given the uncertainty regarding returns of large hatchery salmon.

It should be emphasized that these forecasts are based on assumptions of juvenile populations, overwinter survival, return rate from sea, and proportion of fish returning as small salmon that are subject to wide error. The forecast reflects the cumulated deviations from of all of these assumptions, and therefore is subject to very wide error.

Management considerations

Fish stocking programs may be intended to provide the founding members of a self-sustaining population, to supply fish for a put-and-take fishery, or for both. The drastic decline in angling catches in 1994, following a year in which 2+ smolts were not released, clearly indicates that the major function of salmon stocking on the Morell has been to support a put-and-take fishery. Stocking may also have contributed to the re-establishment of a wild population. However, the number of returns of wild-reared fish is probably lower than total retained catch in many recent years. Hence continued angler expectations can be met only through put-and-take stocking.

Research recommendations

The barrier at the main spillway at Leard's Pond was originally erected to lead fish into the spillway to assure a supply of broodstock for the Cardigan Salmonid Enhancement Centre. Given the importance that counts of ascending salmon at Leard's have assumed, it is essential that all fish that pass through Leard's be enumerated. The barrier at Leard's should therefore be thoroughly inspected and modified as necessary to prevent fish from circumventing it.

The low number of salmon released above Leard's suggests that few salmon should have spawned above Leard's in fall 1994, but the substantial number of redds reported from this area suggests numerous fish and a sizable spawning. To determine whether spawning numbers were indeed very low above Leard's in fall 1994, electrofishing surveys should be conducted in this area in spring 1995. If 0+ fry are absent or nearly so, it could be concluded that few salmon spawned above Leard's in fall 1994, but if numbers are substantial then spawner numbers must also have been substantial.

The survival of salmon released as 1+ smolts should be evaluated by monitoring returns of large salmon in 1995.

Juvenile salmon densities measured by electrofishing appear to be low and suggest that high egg depositions are not resulting in viable offspring. The survival of wild salmon at various life stages should be evaluated, with emphasis on habitat quality as a potential limiting factor.

The exit of smolts from the Morell should be measured in spring 1995 by fyke netting. Numbers from this project would be used to calculate returns of adult salmon and to determine the potential of wild-reared fish to contribute to the spawning population.

Literature Cited

Bielak, A.T., R.W. Gray, T.G. Lutzac, M.J. Hambrook, and P. Cameron. 1991. Atlantic salmon restoration in the Morell River, P.E.I. and the Nepisiguit, N.B., Canada. Pp. 122-139 in D. Mills (Ed.). Proceedings of a joint conference on strategies for the rehabilitation of salmon rivers, London, 1990. The Atlantic Salmon Trust, Institute of Fisheries Management, and the Linnean Society of London.

Davidson, K.G. and R. Angus. 1994. An update on the status of salmonid resources in the Morell, Valleyfield, Dunk, West, and Mill Rivers - Prince Edward Island. DFO Atlantic Fisheries Research Document 94/4.

Davidson, K.G., and A.T. Bielak. 1992. An update on the biological characteristics and status of Atlantic salmon in the Morell River, Prince Edward Island. Can. Atl. Fish. Sci. Adv. Comm. Res. Doc. 92/40.

Ducharme, L.J.A. 1977. Atlantic salmon enhancement in the Morell River, Prince Edward Island. Dept. Fisheries and the Environment Fisheries and Marine Service Tech. Report Ser. MAR/T-77-2.

Dunfield, R.W. 1985. The Atlantic salmon in the history of North America. Can. Spec. Publ. Fish. Aquat. Sci. No. 80.

Jones, C.M., and D.S. Robson. 1991. Improving precision in angler surveys: traditional access design versus bus route design. Amer. Fish. Soc. Symp. 12:177-188.

MacFarlane, R., and D.L. Guignion. 1992. 1991 survey of resident Atlantic salmon anglers on Prince Edward Island. Unpubl. report, Morell River Management Co-op.

MacFarlane, R., and D.L. Guignion. 1993. Survey of Atlantic salmon anglers on Prince Edward Island in 1992. Unpubl. report, Morell River Management Co-op.

Scott, W.B., and E.J. Crossman. 1973. Freshwater fishes of Canada. Fish. Res. Board Can. Bull. no. 184.

Table 1
Some historical landings for commercially caught Atlantic salmon in St. Peter's Bay, Prince Edward Island. Data compiled by Ducharme (1977) from Department of Marine and Fisheries annual reports.

Year	Landings	
	Weight (kg)	Number of fish[1]
1879	909	252
1883	1536	427
1888	710	197
1890	2136	593
1893	727	202
Mean	1244	334

[1]Numbers based on a mean weight of 3.6 kg per fish

Table 2
Summary of Atlantic salmon sport catches on the Morell River, Prince Edward Island, 1955-1994. Data for 1955-1990 are estimates provided by DFO Fisheries Officers (Bielak et al. 1991). Data for 1991-1992 are from an angler mail-out survey conducted by the Morell River Management Co-op (MacFarlane and Guignion 1992, 1993). Data for 1994 are from phone survey.

Year	Number of fish caught and retained			Fishing effort
	Small salmon	Large salmon	Total	(rod-days)
1955			21	18
1956			29	87
1957			3	52
1958			9	52
1959			4	34
1960			4	44
1961			15	45
1962			13	50
1963			51	280
1964			12	46
1965			12	115
1966			10	N/A
1967			26	206
1968			10	192
1969			12	214
1970	0	13	13	204
1971	0	0	0	83
1972	0	7	7	138
1973	2	0	2	168
1974	0	2	2	78
1975	0	0	0	0
1976	6	1	7	250
1977	0	0	0	105
1978	0	0	0	60
1979	1	2	3	54
1980	5	1	6	119
1981	108	4	112	914
1982	73	8	81	2088
1983	7	2	9	686
1984	7	0	7	675
1985[1]	47	N/A	47	1007
1986	236	N/A	236	2725
1987	476	N/A	476	N/A
1988	643	N/A	643	4994
1989	167	N/A	167	4506
1990	768	N/A	768	9000
1991	657	N/A	657	11552
1992	781	N/A	781	11700
1993	N/A	N/A	N/A	N/A
1994	40	0	40	4911

[1]Hook and release was made mandatory for large salmon in 1985.

Table 3
Fishing seasons on the Morell River, 1994.

Area	Includes sites	Period*						
		15 Apr-28 Apr	29 Apr-8 May**	9 May-31 May	1 Jun-15 Sep	16 Sep-14 Oct	15 Oct 31 Oct	1 Nov 30 Nov
From river mouth to just above MacKays	Andersons, Morell, MacKays	T	T	T	T,S	-	-	-
From just above MacKay's to Forks	Indian Bridge, Mooneys Bridge, Grants	T	-	T	T,S;ff	S;ff	S;ff	-
West Branch between the Forks and just below Leard's Pond	Leard's Bridge	T	-	T	T,S;ff	S;ff	-	-
Leard's Pond	Leard's Pond	T	-	T	T,S;ff	S;ff	S;ff	S;ff
West Branch above Leard's Pond	West Branch stream crossings on Peakes Road (Route 320), Pisquid Pond	T	-	T	T,S	-	-	-
East Branch between the Forks and Hazelgreen Road (Route 329)	Cranes	T	-	T	T,S;ff	S;ff	-	-
East Branch above Hazelgreen Road (Route 329)	Kneabone's, Everglades, Martinvale	T	T	T	T,S	-	-	-

*T = open season for trout, S = open season for Atlantic salmon, ff = fly fishing only.
**Closed period for the release of stocked salmon smolts

Table 4
Mean lengths, weights, and fecundities of female salmon sampled from the Morell River, 1989 and 1994.

Size	Mean length in cm (N)	Mean weight in kg (N)	Mean fecundity (N)
Small salmon	56.1 (68)	1.51 (17)	3143 (68)
Large salmon - 1989	73.8 (24)	4.08 (24)	4963 (24)
- 1994	73.0 (17)	3.91 (17)	N/A*
- combined	73.5 (41)	4.01 (41)	–

*Not available until spring 1995

Table 5
Sex ratios for large and small Atlantic salmon from the Leard's Pond fishway, Morell River, 1986-1990 and 1994.

Year	Small salmon				Large salmon			
	Males		Females		Males		Females	
	N	%	N	%	N	%	N	%
1986	520	84.8	93	15.2	N/A	–	N/A	–
1987	471	82.3	101	17.7	5	12.8	34	87.2
1988	547	76.0	173	24.0	11	37.9	18	62.1
1989	196	87.5	28	12.5	15	37.5	25	62.5
1990	131	72.8	49	27.2	29	37.7	48	62.3
1994	33	91.7	3	8.3	4	13.8	25	86.2
Totals	1,898	82.5	447	17.5	64	27.9	150	72.1

Table 6
Area of non-tidal, non-impounded waters of the Mill River, from width measurements taken at 30 m intervals. Data from Cindy Crane and Dave Biggar (unpubl.)

Location	Survey date	Stream length (m)	Length (m) of stream that is ≥ 2.0 m wide	Mean stream width (m), all transects	Mean stream width (m), transects that are ≥ 2.0 m wide	Area (m^2) of stream that is ≥ 2.0 m wide
Main branch of the Mill River from head of tide in Bloomfield Provincial Park to the bridge on the unnumbered road between Forestview and Knutsford.	July & August 1993	10080	9570	5.5	5.64	54009
North branch of the Mill River from its confluence with the main branch at Forestview, to a distance 2730 m upstream.	August 1993	2730	1770	2.1	2.43	4293
Total		12810	11340			58302

Table 7
Area of non-impounded waters of the Dunk River, calculated from width measurements taken at 30 m intervals except for the lower 3.6 km of the main branch between Scales Pond and Route 110, where the measurement interval was 60 m. Data from Robert Redmond (unpubl.).

Location	Survey dates	Stream length (m)	Length (m) of stream that is ≥ 2.0 m wide	Mean stream width (m), all transects	Mean stream width (m), transects that are ≥ 2.0 m wide	Area (m^2) of stream that is ≥ 2.0 m wide
Main branch of the Dunk between the foot of Scales Dam and the Steel Bridge on Rte 110.	7-21 July 1993	7170	7170	14.6	14.6	104682
Main branch of the Dunk between Rte. 232and the head of Scales Pond	20 July-9 August 1993	6120	6120	7.7	7.7	47124
Main branch of the Dunk between Rte. 246 and Rte. 232	16-26 August 1993	3030	3030	6.0	6.0	18180
Shamrock tributary of the Dunk, from Rte. 111to its confluence with the main branch	21-26 July 1993	1080	1080	4.2	4.2	4536
Southwest Brook from Middleton Pond to the confuence with the main branch	1993					18556 *
Total		17400 **	17400 **			193078

*Stream length and widths are unavailable. All or nearly all the measured area is probably => 2 m wide.
**Excludes Southwest Brook

Table 8
Area of non-tidal, non-impounded waters of the West River, from width measurements taken at 30 m intervals. Data from Carl Brydon, Todd Dupuis, and John MacMillan (unpubl.).

Zone	Location	Survey date	Stream length (m)	Length (m) of stream that is ≥ 2.0 m wide	Mean stream width (m), all transects	Mean stream width (m), transects that are ≥ 2.0 m wide	Area (m^2) of stream that is ≥ 2.0 m wide
A	The West River from the head of Crosby's Pond to the next bridge upstream (note: head of tide is at the foot of Crosby's dam)	Aug 1990	5430	5430	8.7	8.7	47427
B	The West River from the first bridge above Crosby's Pond to the bridge on Rte. 249 at Green Bay.	Aug 1990	2670	2670	11.6	11.6	31078
C	The West River from the bridge on Rte 249 at Green Bay to the bridge on Rte 249 at Emyvale.	1990 or 1991	4350	4350	6.9	6.9	30192
D	The West River, from the bridge at Rte. 249 at Emyvale, crossing Rte. 13 at Brookvale, to the bridge on the unnumbered dirt road that runs between Brookvale and Springton.	Aug 1993	4440	4410	5.4	5.4	23839
E	Quinns Brook from the bridge at Rte. 235 to Carragher's Pond in Tyrone	1990 or 1991	3180	3180	4.4	4.4	13907
F	Quinns Brook from the head of Carragher's Pond to a point about 400 m south of Rte. 225.	Aug 1993	1800	1168	2.6	3.2	3704
G	Howells Brook, from its confluence with the West River to Rte. 245.	Sept 1993	960	960	5.1	5.1	4915
H	Howells Brook between Rte. 245 and Rte. 244.	June 1994	1500	1500	4.8	4.8	7188
I	Howells Brook between Rte 244 and the unnumbered road that runs east-west through Elmwood.	Sept 1993	1380	1380	3.7	3.7	5090
J	Tributary of the West River that crosses Route 235 about 300 m south of the intersection of Rtes. 235 and 13. The survey zone runs from the tributary's confluence with the West River to the bridge on Rte. 13.	Aug 1993	2310	2220	3.7	3.8	8465
K	Tributary of the West River that flows through the Brookvale Ski Park parallel to Rte. 13. The survey zone runs from the tributary's confluence with the West River to a point 750 m upstream.	Aug 1993	840	200	1.6	2.1	420
L	Skye Brook (not named on maps), the tributary which flows into the west side of the West River about 1 km above Crosby's Dam. The survey zone runs from the brook's confluence with the West River to a point 3000 m upstream.	July 1993	3000	2621	3.0	3.2	8307
Totals			31860	30089			184530

Table 9
Area of non-tidal, non-impounded waters of the Morell River and its tributaries, from width measurements taken at 30 m intervals. Data from Roseanne MacFarlane, D.L. Guignion, and Todd Dupuis (unpubl.).

Location	Survey date	Water area (m^2)
Main Branch		
Indian Bridge to Mooney's Bridge	July 1991	56843
Mooney's Bridge to Grant's Bridge (Rte 320)	July 1991	28941
Grant's Bridge to Main Forks	July 1991	6710
Subtotal		92494
West Branch		
Main Forks to Leard's Dam	July 1991	29269
Head of west arm of Leard's Pond to a point about 1 km downstream from Peakes Road (Rte. 320)	July 1990	25931
Point about 1 km downstream from Peakes Road to the large spring about 200 m downstream from the upper of the two crossings of the Peakes Road	July 1990	13044
Large spring about 200 m downstream from the upper of the two crossings of Peakes Road to the dam at Mooney's Pond	July 1990	4501
Subtotal		72745
South Branch		
Head of south arm of Leard's Pond to the most downstream crossing of the Old Cardigan Road	July 1990	13941
Most downstream crossing of the Old Cardigan Road to MacAuley's Dam	July 1990	10038
East tributary of South Branch, from forks above MacAuley's Pond to 48 Road (Rte. 5)	July 1992	2601
West Tributary of South Branch, from forks above MacAuley's Pond to 48 Road	July 1992	4671
Subtotal		31251
East Branch		
Main Forks to Crane's Bridge	Oct 1991	5451
Crane's Bridge to Hazelgreen Road (Rte. 329)	Oct 1991	13035
Hazelgreen Road to next forks upstream	Oct 1991	9309
Forks above Hazelgreen Road to Everglades dam	Sept 1991	6582
Forks above Hazelgreen Road to a point 0.6 km downstream from road at Martinvale (Rte. 321)	Sept 1991	6309
Subtotal		40686
Total for South and West Branches above Leard's Pond		74727
Total, all branches		237176

Table 10
Calculated spawning requirements of the Mill, Dunk, West, Morell, and Valleyfield Rivers, based on the biological characteristics of Morell River salmon, and a spawning requirement of 2.4 eggs per m^2 of non-tidal, non-impounded river area. River areas were calculated from field surveys (Tables 6-9). Calculated spawning requirements are based on the assumption that all eggs come from large females. See text for details of calculations.

	Mill	Dunk	West	Morell	Morell above Leard's	Valleyfield	Total
River area (m^2)	58300	193078	184500	237176	74727	127500	800554
Eggs required at 2.4 eggs per m^2	139920	463387	442800	569222	179345	306000	1921330
Mean fecundity (Table 4)	4963	4963	4963	4963	4963	4963	
Number of large female salmon required	28	93	89	115	36	62	387
Percent of large salmon that are female (Table 5)	72.1	72.1	72.1	72.1	72.1	72.1	
Number of large male salmon required	11	36	35	44	14	24	150
Total number of large salmon required	39	129	124	159	50	86	537
Male deficit (number of females - number of males)	17	57	55	70	22	38	237
Percent of small salmon that are male (Table 5)	82.5	82.5	82.5	82.5	82.5	82.5	
Total number of small salmon required, if small salmon meet the male deficit	21	69	66	85	27	46	288
Total number of salmon required	60	199	190	244	77	131	825

Table 11
Numbers of juvenile Atlantic salmon stocked in the Morell River, 1978-1994, and their stages at release. All fish were released in late April or May except 0+ and 1+ parr, which were released in the fall.

Year	Genetic stock	Rearing location	Stage at release					Total number released
			Parr			Smolt		
			0+	1+	2+	1+	2+	
1978	NW Miramichi	Cardigan SEC	14,943					14,943
1979	NW Miramichi	Cardigan SEC	23,012					32,693
	Restigouche		9,681					
1981	NW Miramichi	Cardigan SEC					691	691
1982	Miramichi (EM)[1]	Cardigan SEC	34,764				3,645	38,409
1983	Miramichi (EM)	Cardigan SEC	9,000					9,000
1985	Miramichi mixed[2]	Cardigan SEC					10,428	21,425
		Profitt's Pond					10,997	
1986	NW Miramichi (EM)	Cardigan SEC					1,529	14,058
		Profitt's Pond					12,529	
1987	NW Miramichi (EM)	Cardigan SEC					3,055	23,305
		Profitt's Pond					22,250	
1988	Miramichi mixed	Cardigan SEC				5,907		20,097
		Profitt's Pond			1,208		12,982	
1989	Morell (HR-small salmon)[3]	Profitt's Pond			1,560		20,650	22,210
1990	Morell mixed (HR)	Mooney's Pond			398		48,475	59,810
		Profitt's Pond			681		10,256	
1991	Morell mixed (HR)	Mooney's Pond			2,051		35,745	37,796
1992	Morell mixed (HR)	Mooney's Pond			2,349		41,422	45,971
	Morell mixed (HR)	Mooney's Pond		2200[4]				
1993	Morell mixed (HR)	Cardigan SEC				19,379		19,379
1994	Morell mixed (HR)	Mooney's Pond			698		22,153	26,000[5]

[1]EM - early migrating stock
[2]Mixed - Both early and late migrating stock were taken for transfer because of the small number of eggs available
[3]HR - Progeny from previous hatchery stocking in the Morell River
[4]These fish were the survivors of a die-off of salmon in Mooney's Pond in the summer of 1992. They were released directly from the Pond into the river. Numbers are approximate.
[5]Includes an estimated 3,000 smolt and parr which were released without counting. Does not include an unknown number which escaped through a gap in the stoplogs.

Table 12
A summary of the distribution of juvenile Atlantic salmon stocked in the West, Dunk, Mill, Valleyfield, and Midgell Rivers, 1985-1994.

Year	Rearing location	Stage stocked	Date stocked	Numbers stocked				
				West River	Dunk River	Mill River	Valleyfield River	Midgell River
1985	Cardigan SEC	2+ smolt	June 6	0	0	1,609	0	0
	Profitt's Pond	2+ smolt	May 21-30	0	0	733	0	0
1986	Profitt's Pond	2+ parr	May 15-28	0	0	580	0	0
		2+ smolt	May 15-28	0	0	2,417	0	0
1987	Profitt's Pond	2+ parr	May 16-19	0	0	595	0	0
		2+ smolt	May 16-19	0	0	2,555	0	0
1988	Cardigan SEC	1+ smolt	May 23	1,390	0	0	0	0
	Profitt's Pond	2+ parr	May 12-13	0	0	349	0	0
		2+ smolt	May 12-13	0	0	3,079	0	0
1989	Cardigan SEC	1+ parr	May 8-12	0	0	0	2,491	0
		1+ smolt	May 8-12	0	0	0	6,299	0
	Profitt's Pond	2+ smolt	May 15	1,324	0	0	0	0
		2+ parr	May 12-16	0	0	74	0	0
		2+ smolt	May 12-16	0	0	2,991	0	0
1990	Cardigan SEC	0+ parr	Nov 16-Dec 10	0	0	0	89,003	0
		1+ smolt	May 27-30	0	0	0	738	0
	Profitt's Pond	2+ parr	May 4-8	0	0	25	0	0
		2+ smolt	May 4-8	0	0	3,082	0	0
1991	Cardigan SEC	0+ parr	Nov 13-15	0	0	0	55,723	0
		0+ parr	Nov 20-23	50,750	0	0	0	0
		1+ smolt	May 7 - June 5	0	0	0	5,259	0
	Profitt's Pond	2+ parr	May 6-10	0	0	159	0	0
		2+ smolt	May 6-10	0	717	1,873	0	0
	Mooney's Pond	2+ smolt	May 10-11	0	1,300	0	0	0
1992	Cardigan SEC	0+ parr	Nov 12	0	0	0	32,494	0
		2+ smolt	May 13-16	0	0	0	1,693	0
	Profitt's Pond	2+ parr	May 4-5	0	0	169	0	0
		2+ smolt	May 4-5	1,260	0	3,657	0	0
	Mooney's Pond	1+ parr	Sept 21-Oct 1	0	0	0	10,014	0
			Sept 28-29	10,173	0	0	0	0
		2+ smolt	May 13-16	0	0	0	10,307	0
			May 11-20	10,221	0	0	0	0
1993	Cardigan SEC	0+ parr	Oct 13	0	0	0	14,467	0
			Dec 1	0	0	0	0	20,000
		1+ parr	June 16-23	0	0	0	28,898	0
	Profitt's Pond	1+ parr	May 28-June 22	0	17,225	0	0	0
		2+ parr	May 3-4	0	0	200	0	0
		2+ smolt	May 3-4	0	5,325	2,772	0	0
1994	Cardigan SEC	0+ parr	Nov 26	0	0	0	20,000	20,000
		1+ smolt	May 9-10	0	0	0	5,896	0
			May 12-15	3,965	0	0	0	0
	Profitts Pond	2+ parr	May 2-3	209	341	127	0	0
		2+ smolt	May 2-3	3,355	7,259	2,584	0	0
	Mooney's Pond	2+ smolt	Apr 28-May 7	0	0	0	1,980	0

Table 13
Angler catch and effort at the principal angling sites of the Morell River, estimated by creel census in 1994

Period	Station	Clerk time at station (h)	Anglers exiting while the clerk was at the station			Total angling time (h) reported by anglers giving full interviews	Total catch reported by anglers giving full interviews								Estimated total angling exits	Estimated total angling hours	Estimated total catch							
			Anglers giving full interviews	Anglers not giving full interviews	Total anglers		Brook trout kept	Brook trout released	Rainbow trout kept	Rainbow trout released	Juvenile salmon released	Small salmon released	Large salmon released	Black salmon released			Brook trout kept	Brook trout released	Rainbow trout kept	Rainbow trout released	Juvenile salmon released	Small salmon released	Large salmon released	Black salmon released
Opening weekend (Friday-Sunday, 15-17 April)	Anderson's	12.6	19	0	19	111.5	13	0	0	0	0	0	0	0	68.1	393.8	44.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Crane's	4.3	0	2	2	0.0	0	0	0	0	0	0	0	0	16.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Grant's	3.1	4	2	6	7.1	0	0	0	0	0	0	0	0	61.6	105.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Indian Bridge	4.2	12	0	12	43.9	17	10	0	0	0	0	0	17	136.8	506.4	198.5	96.8	0.0	0.0	0.0	0.0	0.0	189.3
	Leard's	4.5	9	0	9	12.9	9	2	0	0	0	0	0	0	91.7	131.2	83.4	14.5	0.0	0.0	0.0	0.0	0.0	0.0
	MacKay's	5.1	12	0	12	32.8	3	2	0	0	0	0	0	0	100.3	298.3	31.3	21.0	0.0	0.0	0.0	0.0	0.0	0.0
	Morell	20.6	122	7	129	924.8	177	9	0	0	0	0	0	9	273.6	2043.5	394.0	20.0	0.0	0.0	0.0	0.0	0.0	19.6
	Subtotal	54.4	178	11	189	1132.9	219	23	0	0	0	0	0	26	748.9	3478.6	751.7	152.3	0.0	0.0	0.0	0.0	0.0	208.9
18-30 April	Anderson's	5.3	10	0	10	34.6	0	0	0	0	0	0	0	0	608.1	2102.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Crane's	3.3	0	0	0	0.0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Grant's	4.3	7	0	7	8.5	1	5	0	0	0	0	0	0	211.3	227.8	43.8	147.5	0.0	0.0	0.0	0.0	0.0	0.0
	Indian Bridge	4.9	6	0	6	29.9	1	0	0	0	0	0	0	1	189.2	976.2	34.3	0.0	0.0	0.0	0.0	0.0	0.0	34.3
	Leard's	5.1	2	0	2	2.2	0	1	0	0	0	0	0	0	87.0	97.2	0.0	43.5	0.0	0.0	0.0	0.0	0.0	0.0
	MacKay's	9.1	31	2	33	91.7	8	4	0	0	0	0	0	1	463.3	1100.4	83.3	50.5	0.0	0.0	0.0	0.0	0.0	10.5
	Morell	6.5	12	2	14	95.3	7	3	0	0	0	0	0	3	685.5	1581.6	100.5	48.2	0.0	0.0	0.0	0.0	0.0	48.2
	Subtotal	38.5	68	4	72	262.2	17	13	0	0	0	0	0	5	2244.4	6085.1	261.8	289.6	0.0	0.0	0.0	0.0	0.0	93.0
May	Anderson's	5.9	0	4	4	0.0	0	0	0	0	0	0	0	0	214.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Crane's	5.7	1	0	1	0.3	0	0	0	0	0	0	0	0	147.1	36.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Grant's	17.7	11	2	13	17.1	0	23	0	0	1	0	0	0	449.8	414.9	0.0	412.9	0.0	0.0	79.0	0.0	0.0	0.0
	Indian Bridge	15.1	13	3	16	43.9	4	11	0	0	0	0	0	0	635.7	2706.9	346.3	551.7	0.0	0.0	0.0	0.0	0.0	0.0
	Leard's	15.8	3	0	3	9.5	0	0	0	0	0	0	0	0	94.9	300.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	MacKay's	22.4	13	0	13	24.3	0	3	0	0	0	0	0	0	198.4	349.8	0.0	28.2	0.0	0.0	0.0	0.0	0.0	0.0
	Morell	25.1	22	1	23	119.4	16	1	0	0	0	0	0	0	436.2	2520.9	376.3	45.0	0.0	0.0	0.0	0.0	0.0	0.0
	Subtotal	107.6	63	10	73	214.5	20	38	0	0	1	0	0	0	2177.0	6329.8	722.6	1037.8	0.0	0.0	79.0	0.0	0.0	0.0
June	Crane's	10.8	3	0	3	8.5	0	3	0	0	0	0	0	0	64.3	182.1	0.0	64.3	0.0	0.0	0.0	0.0	0.0	0.0
	Grant's	29.0	24	1	25	54.1	3	9	0	0	4	0	0	0	471.9	1030.7	42.2	187.4	0.0	0.0	100.0	0.0	0.0	0.0
	Indian Bridge	20.2	26	2	28	67.8	0	18	0	0	1	0	0	0	575.0	1455.1	0.0	370.0	0.0	0.0	21.2	0.0	0.0	0.0
	Leard's	24.4	2	0	2	8.3	0	0	0	0	0	0	0	0	47.5	196.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	MacKay's	15.7	5	0	5	2.5	0	0	0	0	0	0	0	0	104.3	83.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Morell	20.6	3	0	3	15.1	0	0	0	0	0	0	0	0	78.8	411.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Subtotal	120.7	63	3	66	156.2	3	30	0	0	5	0	0	0	1341.9	3359.2	42.2	621.7	0.0	0.0	121.2	0.0	0.0	0.0
July	Crane's	13.9	0	0	0	0.0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Grant's	27.3	30	6	36	87.3	1	10	0	1	1	0	0	0	726.9	2240.1	10.4	323.9	0.0	12.8	10.4	0.0	0.0	0.0
	Indian Bridge	24.9	14	3	17	48.2	1	2	1	0	0	0	0	0	315.1	1104.9	16.3	67.3	33.6	0.0	0.0	0.0	0.0	0.0
	Leard's	29.3	6	1	7	18.0	0	1	0	0	0	0	0	0	138.8	502.8	0.0	41.9	0.0	0.0	0.0	0.0	0.0	0.0
	Mooney's Road	19.6	2	1	3	2.8	0	1	0	0	1	0	0	0	71.5	68.6	0.0	24.8	0.0	0.0	24.8	0.0	0.0	0.0
	Subtotal	115.0	52	11	63	156.2	2	14	1	1	2	0	0	0	1252.2	3916.4	26.6	457.9	33.6	12.8	35.1	0.0	0.0	0.0
August	Leard's	12.6	0	0	0	0.0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Grant's	21.9	18	1	19	71.1	0	4	0	0	0	0	1	0	474.5	1902.9	0.0	107.7	0.0	0.0	0.0	0.0	23.1	0.0
	Indian Bridge	25.1	14	3	17	47.0	0	1	0	0	0	0	0	0	293.7	970.4	0.0	11.7	0.0	0.0	0.0	0.0	0.0	0.0
	Leard's	21.4	2	0	2	8.0	0	0	0	0	0	0	0	0	13.9	55.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Mooney's Road	24.3	1	2	3	6.3	0	0	0	0	0	0	0	0	67.9	210.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Subtotal	105.2	35	6	41	132.3	0	5	0	0	0	0	1	0	849.9	3139.3	0.0	119.4	0.0	0.0	0.0	0.0	23.1	0.0
September	Crane's	6.9	1	0	1	2.8	0	0	0	0	0	0	0	0	19.8	54.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Grant's	13.6	7	3	10	25.6	0	2	0	0	0	0	0	0	186.5	568.7	0.0	42.9	0.0	0.0	0.0	0.0	0.0	0.0
	Indian Bridge	12.5	11	2	13	30.9	0	3	0	0	0	0	1	0	670.6	2131.8	0.0	157.9	0.0	0.0	0.0	0.0	132.0	0.0
	Leard's	11.7	3	0	3	6.3	0	0	0	0	0	0	0	0	93.6	193.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Mooney's Road	13.6	0	0	0	0.0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Subtotal	58.3	22	5	27	65.6	0	5	0	0	0	0	1	0	970.5	2948.5	0.0	200.8	0.0	0.0	0.0	0.0	132.0	0.0
October	Crane's	2.1	0	0	0	0.0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Grant's	10.0	12	3	15	21.6	0	1	0	0	0	0	0	0	999.9	2347.2	0.0	16.9	0.0	0.0	0.0	0.0	0.0	0.0
	Indian Bridge	9.0	4	0	4	12.6	0	2	0	0	0	0	0	0	73.3	230.7	0.0	36.7	0.0	0.0	0.0	0.0	0.0	0.0
	Leard's	9.2	3	0	3	1.5	0	0	0	0	0	0	0	0	158.5	63.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Mooney's Road	8.4	0	0	0	0.0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Subtotal	38.7	19	3	22	35.7	0	3	0	0	0	0	0	0	1231.7	2641.7	0.0	53.6	0.0	0.0	0.0	0.0	0.0	0.0
November	Leard's	22.5	8	0	8	26.1	0	1	0	0	0	0	0	0	120.0	391.3	0.0	15.0	0.0	0.0	0.0	0.0	0.0	0.0
Total		660.9	508	53	561	2161.7	261	132	1	1	8	0	2	31	10936.7	32289.7	1805.0	2948.1	33.6	12.8	235.4	0.0	155.1	301.9

Table 14
Returns of Atlantic salmon to the Leard's Pond fishway, 1981-1994

Year	All salmon				Small salmon					Large salmon				
	Wild	Hatch-ery	Total	% wild	Wild	Hatch-ery	Total	% wild	% small	Wild	Hatch-ery	Total	% wild	% large
1981	6	39	45	13.3	0	39	39	0.0	86.7	6	0	6	100.0	13.3
1982	7	29	36	19.4	6	27	33	18.2	91.7	1	2	3	33.3	8.3
1983	1	3	4	25.0	1	1	2	50.0	50.0	0	2	2	0.0	50.0
1984	5	4	9	55.6	3	2	5	60.0	55.6	2	2	4	50.0	44.4
1985	3	12	15	20.0	2	12	14	14.3	93.3	1	0	1	100.0	6.7
1986	3	623	626	0.5	1	619	620	0.2	99.0	2	4	6	33.3	1.0
1987	4	1232	1236	0.3	2	1166	1168	0.2	94.5	2	66	68	2.9	5.5
1988	10	1471	1481	0.7	8	1386	1394	0.6	94.1	2	87	89	2.2	6.0
1989	12	448	460	2.6	12	323	335	3.6	72.8	0	125	125	0.0	27.2
1990	48	424	472	10.2	44	365	409	10.8	86.7	4	59	63	6.3	13.3
1991	44	322	366	12.0	33	294	327	10.1	89.3	11	28	39	28.2	10.7
1992	72	881	953	7.6	64	843	907	7.1	95.2	8	38	46	17.4	4.8
1993	44	595	639	6.9	44	584	628	7.0	98.3	0	11	11	0.0	1.7
1994	10	55	65	15.4	8	28	36	22.2	55.4	2	27	29	6.9	44.6
Total	269	6138	6407		228	5689	5917			41	451	492		
Mean	19	438	458	4.2	16	406	423	3.9	92.4	2.9	32	35	8.3	7.7

Table 15
Counts of Atlantic salmon and brook trout at counting facilities on the West, Dunk, Mill and Valleyfield Rivers, 1986-1994.

Year	Direction	West River		Dunk River		Mill River		Valleyfield River	
		Trout	Salmon	Trout	Salmon	Trout	Salmon	Trout	Salmon
1986	Upstream							723	0
	Downstream							–	–
1987	Upstream			937				–	–
	Downstream			–				–	–
1988	Upstream			1,507				–	–
	Downstream			–				–	–
1989	Upstream	–	31 small salmon, 19 large salmon	4,189				1,220	0
	Downstream	–	–	–				–	–
1990	Upstream	3,935	25 small salmon, 23 large salmon	–		2,594	176	2,173	36 small salmon
	Downstream	2,986	–	–		–	–	–	–
1991	Upstream	–	–	1,733		4,221	–	1,565	5 small salmon
	Downstream	–	–	–		–	–	–	–
1992	Upstream	–	–	1,132		–	–	741	25 small salmon
	Downstream	–	–	–		–	–	–	–
1993	Upstream	2,151	250 (248)* small salmon, 12 (12) large salmon	1,295	0	219	22	1,027	84 small salmon
	Downstream	1,006	10 adults 66 parr	–	–	–	–	–	–
1994**	Upstream	2,072	6 (6) large salmon***, 8 (4) small salmon	N/A	N/A	1,947	11 (11) small salmon	1,609	15 small salmon, 7 large salmon
	Downstream		1 small salmon, 1 large salmon						

*Numbers of hatchery-reared salmon are bracketed

**Counting facilities operated from 30 May to 17 September (West River), from 27 May to 27 October (Mill River), and from 29 May to 3 November (Valleyfield River).

***Every second conduit was removed from the counting fence, allowing small salmon to pass through the fence.

Table 16
Estimates of Atlantic salmon and brook trout densities at electrofishing sites on the Morell River, 1975-1994.

Site	Date	Water temperature (oC)	Area of site (m2)*	Atlantic salmon**												Brook trout									
				Fish captured in sweep							Zippen estimates					Fish captured in sweep							Zippen estimates		
				1	2	3	4	5	6	Total	% of fish aged 0+	Total pop. in site	Fish density within site: 0+ fish/ 100 m2	1+ fish/ 100 m2	total fish/ 100 m2	95% confidence interval	1	2	3	4	5	6	Total	Total pop. in site	Density (fish/ 100 m2)	95% confidence interval
1975***																									
Below Leard's Pond	8-12 Sep												0.0	5.1	5.1										
Below Forks	8-12 Sep												0.0	5.9	5.9									5.5	
Grant's Bridge	8-12 Sep												0.0	3.8	3.8									14.2	
Mooney's Bridge	8-12 Sep												0.0	1.5	1.5									8.8	
Below Indian Bridge	8-12 Sep												0.0	0.6	0.6									6.5	
																								5.1	
1984																									
Kenny's Hole																									
All fish	22 Aug	21.0	336.0	4	1	2	1	0		8	0	8.5	0.0	2.5	2.5	****	7	7	6	1	2		23	27.3	8.1	
Wild fish										2	0	2.1	0.0	0.6	0.6										
Hatchery fish										6	0	6.4	0.0	1.9	1.9										
Leard's Bridge																									
All fish	23 Aug	21.0	304.9	36	13	4	6	1		60	85	61.1	17.0	3.0	20.0	± 6%	0	0	0	0	0		0	0.0	0.0	
Wild fish										56	91	57.0	17.0	1.7	18.7										
Hatchery fish										4	0	4.1	0.0	1.3	1.3										
Crane's	30 Aug		400.0	16	9	2	0	1	3	31	84	31.8	6.7	1.3	8.0	****	7	7	4	3	3	3	27	37.2	9.3	
Forks																									
All fish	11 Sep	15.0	363.3	25	22	10	1			58	57	62.8	9.8	7.5	17.3	14%	5	3	5	2			15	28.3	7.8	
Wild fish										57	58	61.7	9.8	7.2	17.0										
Hatchery fish										1	0	1.1	0.0	0.3	0.3										
1985																									
Kenny's Hole	21 Aug	21.0	466.0	4	5	1	1			11	0	12.7	0.0	2.7	2.7	****	68	39	13	21			141	162.3	34.8	± 12%
Leard's Bridge	22 Aug		541.0	27	29	23	12	3		94	53	112.0	11.0	9.7	20.7	± 19%	9	5	2	3	3		22	27.1	5.0	
Lower Leard's	23 Aug	18.5	347.3	10	6	14	4	2		36	72	49.8	10.4	4.0	14.3	****	2	2	4	1	1		10	18.8	5.4	± 79%
Crane's	27 Aug		400.0	11	2	4	1	0		18	56	18.3	2.5	2.0	4.6	****	17	9	10	7	2		45	53.1	13.3	
Mooney's Bridge	28 Aug		374.0	6	6	8	2			22	64	42.3	7.2	4.1	11.3	****	16	1	1	2			20	20.3	5.4	
Rowell's Riffle	5 Sep		183.1	10	5	3	4	0		22	73	23.6	9.4	3.5	12.9	****	12	3	4	2	1		22	23.2	12.7	
1994																									
Kenny's Hole	23 Aug	16.0	201.0	77	60	39				176	78	280.2	109.3	30.1	139.4	± 37%	32	18	5				55	60.2	29.9	± 16%
Leard's Bridge	24 Aug	17.7	216.4	19	12	7	5			43	81	60.0	22.6	5.2	27.7	± 26%	0	0	0	0			0	0	0.0	****
Crane's	30 Aug	17.5	352.1	35	23	21	15			94	95	138.9	37.3	2.1	39.5	± 42%	28	15	16	24			83	*****	*****	
Forks	1 Sep	15.2	393.0	37	30	24	14			105	68	152.2	26.2	12.5	38.7	± 37%	12	13	7	5			37	53	13.5	± 71%
Mooney's Bridge	6 Sep	15.0	393.0	5	4	3	0			12	42	13.0	1.4	1.9	3.3	****	6	2	4	1			13	16	4.1	****
Rowell's Riffle	7 Sep	14.5	324.0	9	5	4	1			19	16	21.1	1.0	5.5	6.5	****	21	7	2	0			30	30.2	9.3	****
Kenny's Hole	15 Dec	0	201	20							100						30									
Leard's Bridge	16 Dec	0	210	13							77						4									
Crane's	16 Dec	0	340	11							91						23									
Forks	20 Dec	0	375	8							88						11									
Mooney's Bridge	23 Dec		295	2							0						1									
Rowell's Riffle	27 Dec		310	5							0						7									

*For December 1994, site area is the estimated area of open water after ice removal.
**Atlantic salmon less than 9.5 cm fork length were assumed to be 0+ fish; all others were assumed to be 1+.
***Data from Ducharme (1977). Exact locations of sites were not recorded (L.J.A. Ducharme, pers. comm.). Densities were estimated by Delury's (1951) method.
****Not possible to calculate confidence limits because of small sample size.
*****Confidence limits exceed +- 100%.

Table 17

Estimates of Atlantic salmon populations in the Morell River, based on electrofishing density estimates and measurements of rearing habitat.

River section	River area (m2)*	Electrofishing site	Estimated densities in electrofishing sites			Estimated populations				Adults ascending Leard's fishway****	
			0+ fish/ 100 m2	1+ fish/ 100 m2	2+ fish/ 100/m2**	0+ fish	1+ fish	2+ fish**	Returning adults***	Small salmon	Large salmon
1975											
West Branch											
Leard's Pond to Forks	29269	Below Leard's Pond	0.0	5.1	2.6	0	1493	746	14.9		
Main stem	92494	Mean of Below Forks, Grant's Bridge, Mooney's Bridge, & Below Indian Bridge	0.0	3.0	1.5	0	2729	1364	27.3		
1984 - Wild-reared fish											
West Branch											
Above Leard's Pond	74727	Kenny's Hole	0.0	0.6	0.3	0	473	236	4.7	1	2
Leard's Pond to Forks	29269	Leard's Bridge	17.0	1.7	0.8	4987	487	244	4.9		
East Branch	40686	Crane's	6.7	1.3	0.6	2714	521	260	5.2		
Main stem	92494	Forks	9.8	7.2	3.6	9098	6615	3308	66.2		
Total	237176					16799	8096	4048	81.0		
1984 - Hatchery-reared fish***											
West Branch											
Above Leard's Pond	74727	Kenny's Hole	0.0	1.9	0.9	0	1418	709	14.2	619	66
Leard's Pond to Forks	29269	Leard's Bridge	0.0	1.3	0.7	0	391	196	3.9		
East Branch	40686	Crane's	0.0	0.0	0.0	0	0	0	0.0		
Main stem	92494	Forks	0.0	0.3	0.1	0	276	138	2.8		
Total	237176					0	2084	1042	20.8		
1985											
West Branch											
Above Leard's Pond	74727	Kenny's Hole	0.0	2.7	1.4	0	2037	1018	20.4	2	2
Leard's Pond to Forks	29269	Mean of Leard's Bridge & Lower Leard's	10.7	6.8	3.4	3127	2001	1001	20.0		
East Branch	40686	Crane's	2.5	2.0	1.0	1035	826	413	8.3		
Main stem											
Forks to Mooney's Bridge	35651	Mooney's Bridge	7.2	4.1	2.1	2564	1468	734	14.7		
Mooney's Bridge to Indian Bridge	56843	Rowell's Riffle	9.4	3.5	1.8	5326	2000	1000	20.0		
Total	237176					12053	8332	4166	83.3		
1994											
West Branch											
Above Leard's Pond	74727	Kenny's Hole	109.3	30.1	15.1	81652	22496	11248	225.0		
Leard's Pond to Forks	29269	Leard's Bridge	22.6	5.2	2.6	6605	1509	755	15.1		
East Branch	40686	Crane's	37.3	2.1	1.1	15184	867	433	8.7		
Main stem											
Forks to Mooney's Bridge	35651	Mean of Forks & Mooney's Bridge	13.8	7.2	3.6	4913	2580	1290	25.8		
Mooney's Bridge to Indian Bridge	56843	Rowell's Riffle	1.0	5.5	2.7	585	3117	1558	31.2		
Total	237176					108938	30569	15285	305.7		

*From Table 9

**Estimates for smolts heading to sea in the following spring, based on 50% mortality of 1+ fish.

***Assumes that 2% of smolts that exit the river return as adults.

****Counts are for the year in which the cohort would be expected to return; e.g. for 1+ fish in 1984, small salmon counts are for 1986 and large salmon salmon counts are for 1987.

*****9,000 0+ salmon were released into the Morell in 1983 and 21,425 2+ smolts were released in 1985.

Table 18
Counts of Atlantic salmon redds in selected Prince Edward Island rivers, 1990-1994. Data are from C. Crane and D. Biggar (Mill River), C. Brydon and T. Dupuis (West River), S. Hill (Dunk River), and I. Premdas, D.L. Guignion and T. Dupuis (Morell River).

River	Sector	Number of salmon redds				
		1990	1991	1992	1993	1994
Mill					311	144
West						
	Sector 1 - Head of tide to first bridge above Crosby's Pond	6	n/a	15	6	17
	Sector 2 - First bridge above Crosby's Pond to bridge on Rte. 249 at Green Bay	41	19	168	77	25
	Sector 3 - Bridge on Rte 249 at Green Bay to bridge on Rte 249 at Emyvale	n/a	4	91	59	n/a
	Sector 4 - Bridge on Rte. 249 at Emyvale to the point where the main branch crosses Rte. 13 at Brookvale; also the tributary to the bridge on Rte. 235	n/a	5	n/a	22	17
	Sector 5 - From bridge on Rte. 235 at Brookvale, following the east branch to the bridge on Rte. 225 at Hartsville	n/a	0	n/a	n/a	n/a
	Sector 6 - From Bridge at Rte. 235 to Carragher's Pond, just above Rte. 244.	n/a	2	n/a	0	n/a
	Sector 7 - From the head of Carragher's Pond to the bridge at Rte. 245	n/a	0	n/a	n/a	n/a
	Sector 8 - Howell's Brook from the bridge on Rte. 245 to the bridge on Rte. 244	n/a	3	n/a	0	0
Dunk	Head of tide to Scales Pond	n/a	n/a	n/a	6	n/a
Morell	Main Branch, West Branch from Forks to dam at Leard's Pond	89	204			65
	West Branch above Leard's Pond	158	177			17
	South Branch	207	118			45*
	East Branch	202	138			35
	Total above Leard's Pond	365	295			62
	Total	656	637	917	362	162

*Survey incomplete

Table 19
Total returns, numbers released above Leard's Pond, and potential egg deposition in the Morell River above Leard's Pond from small and large Atlantic salmon, 1981-1994. Depositions are based on the assumption that sex ratios are as given in Table 4 except where footnoted, fecundities are as in Table 5, and that all females spawned. The target above Leard's Pond is 179,345 eggs (Table 10).

Year	Total returns		Total released above Leard's Pond		Egg deposition above Leard's Pond			
	Small salmon	Large salmon	Small salmon	Large salmon	Small salmon	Large salmon	Total	Percent of target
1981	39	6	39	6	21451	21470	42921	24
1982	33	3	33	3	18151	10735	28886	16
1983	2	2	2	2	1100	7157	8257	5
1984	5	4	5	4	2750	14313	17063	10
1985	14	1	14	1	7700	3578	11279	6
1986	620	6	278[1]	3[2]	339444	14889	354333	198
1987	1168	68	658	54	361916	193229	555146	310
1988	1394	89	1290	20	709532	71566	781099	436
1989	335	125	330	48	181508	171760	353268	197
1990	409	63	368	44	202409	157446	359855	201
1991	327	39	280	14	154007	50097	204104	114
1992	907	46	824	14	453221	50097	503317	281
1993	628	11	461	0	253562	0	253562	141
1994	36	29	2[3]	3[2]	3143	14889	18032	10

[1] 108 females
[2] 2 All females
[3] 1 male, 1 female

Table 20
Estimates of sea survival of Atlantic salmon stocked into the Morell River, Prince Edward Island from the Cardigan Salmonid Enhancement Centre (SEC), Profitt's Pond semi-natural rearing facility, and Mooney's Pond semi-natural rearing facility, 1985-1993.

Year of release (Yr)	Rearing location	Number released above Leard's Pond	Returns to Leard's Pond fishway		Sport fishery catches below Leard's Pond	Total recaptures	Sea survival %
			Small salmon (Yr+1)	Large salmon (Yr+2)			
1985	Cardigan SEC	10,428	96	10	44	150	1.4
	Profitt's Pond	10,997	523	56	192	771	7.0
1986	Cardigan SEC	1,529	74	6	23	103	6.7
	Profitt's Pond	12,529	1,094	79	335	1,508	12.0
1987	Cardigan SEC	3,055	84	1	7	92	3.0
	Profitt's Pond	22,250	1,302	125	111	1,538	6.9
1988	Cardigan SEC Profitt's Pond	14,589 combined	335	59	129	523	3.6
1989	Profitt's Pond	9,393	365	28	768*	393_{min}-$1,161_{max}$**	4.2_{min}-12.4_{max}**
1990	Mooney's Pond	48,478	294	38	657*	332_{min}-989_{max}**	0.7_{min}-2.0_{max}**
1991	Mooney's Pond	26,636	843	11	781*	854_{min}-$1,624_{max}$**	3.2_{min}-6.1_{max}**
1992	Mooney's Pond	40,702	584	27	N/A	611_{min}- N/A**	1.5_{min}-N/A**
1993	Cardigan SEC	19,379***	28	33	N/A		

*Total estimated catch for the whole Morell River
**Minimum value assumes none of the sport catch occurred below Leard's Pond, while the maximum value assumes all of the sport catch occurred below Leard's Pond
***1+ smolt; all other smolts stocked were 2+

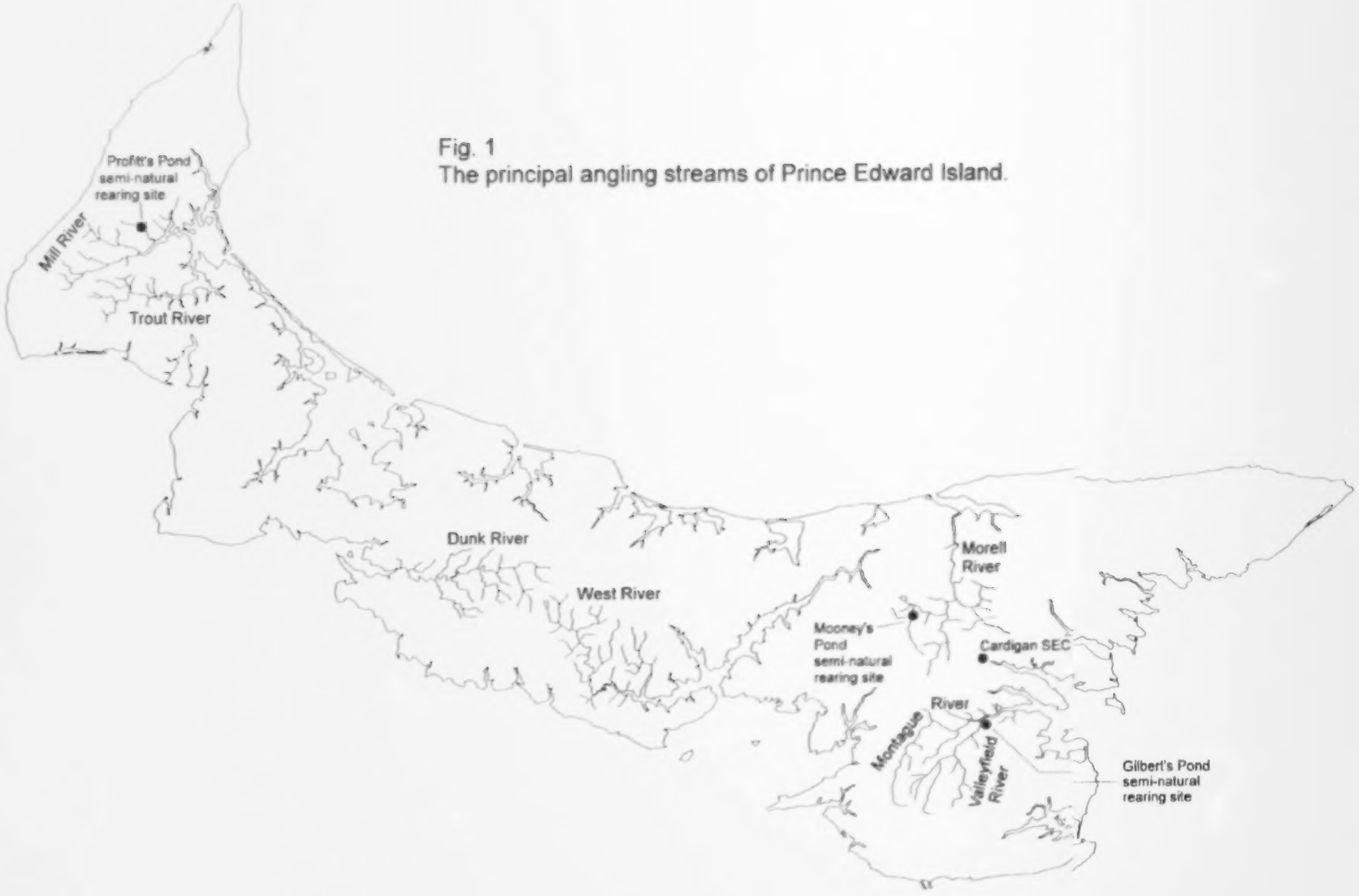
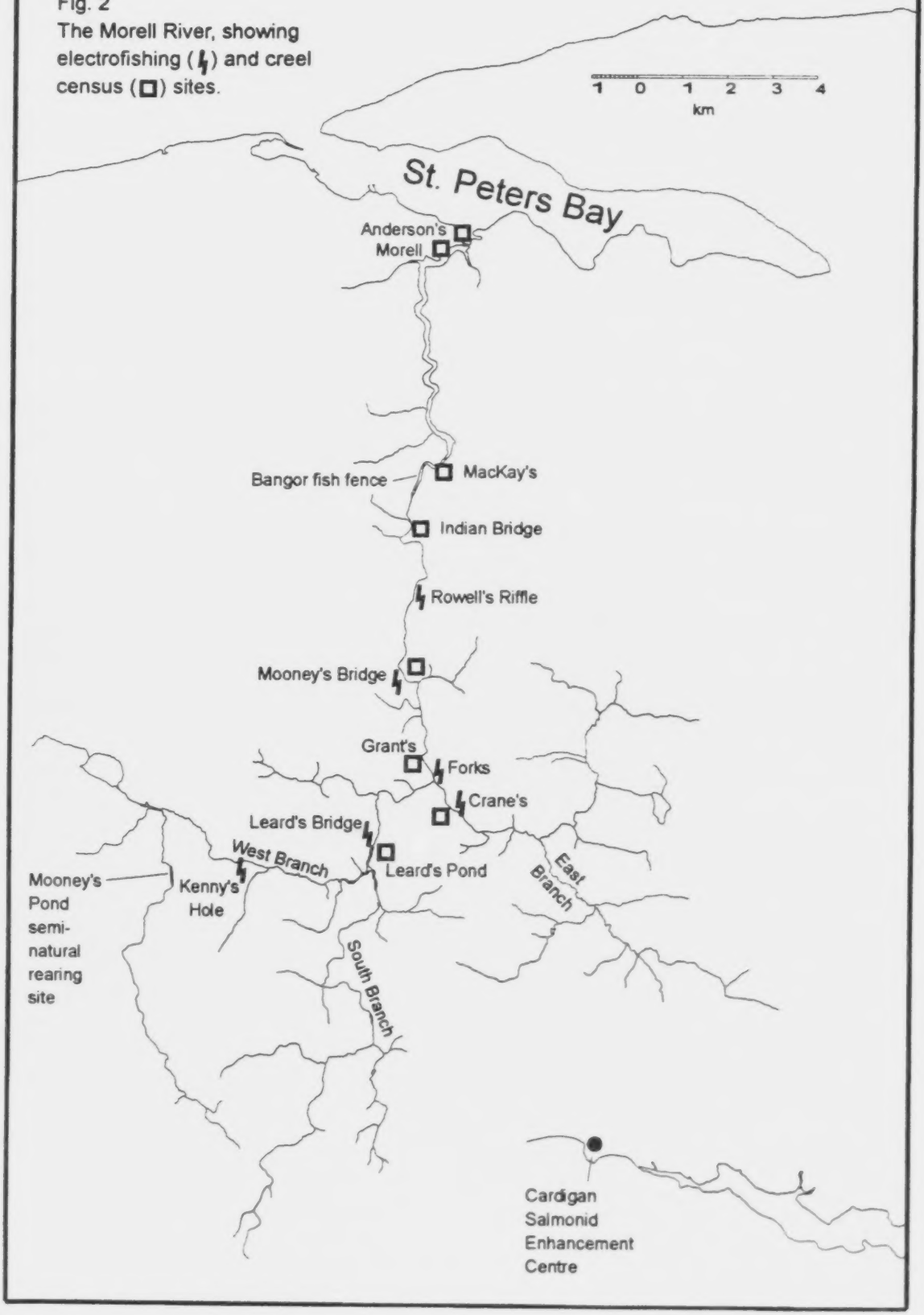


Fig. 1
The principal angling streams of Prince Edward Island.

Fig. 2
The Morell River, showing electrofishing (ϟ) and creel census (□) sites.



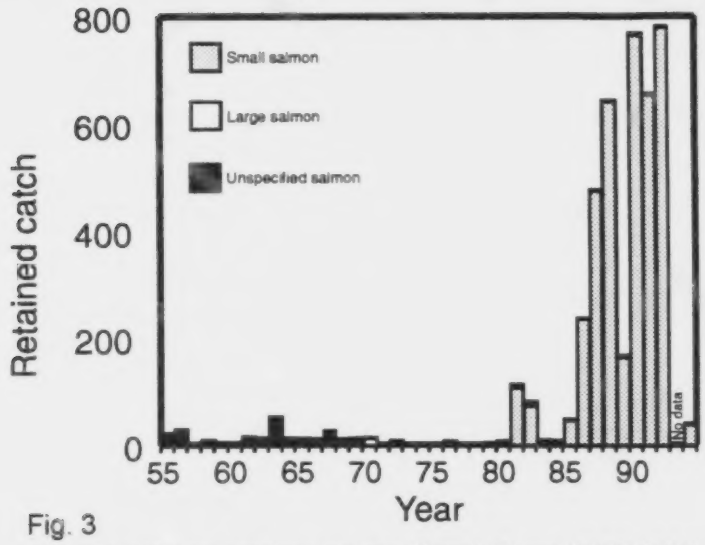


Fig. 3
Atlantic salmon catches on the Morell River, 1955-1994.

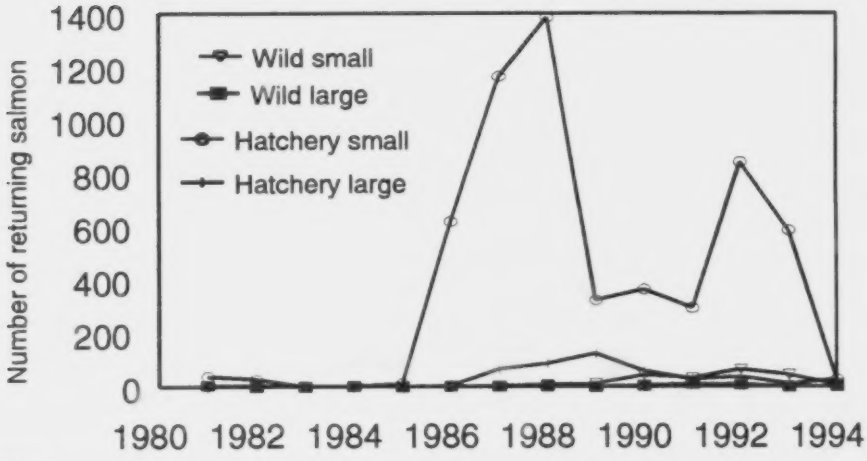


Fig. 4
Atlantic salmon returns to the Leard's Pond fishway, 1981-1994.

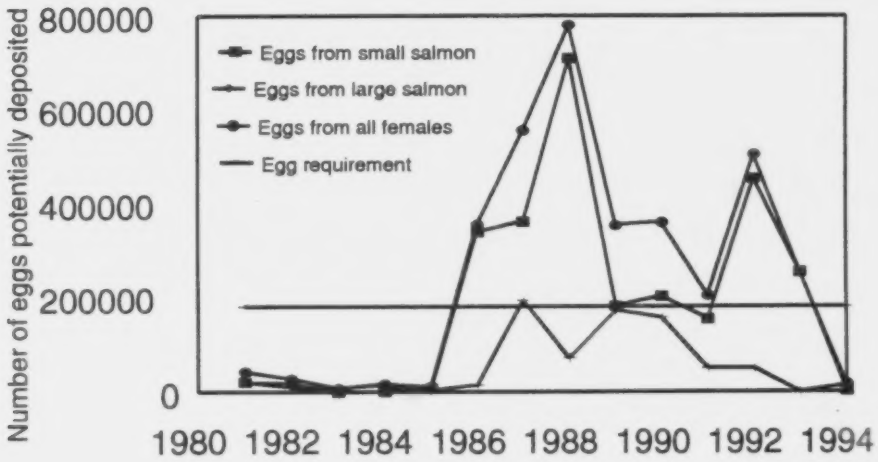


Fig. 5
Potential egg deposition by salmon released above Leard's dam, 1981-1994.

Fig. 6

Run Timing Data for Morell River Salmon Based on Counts at Leard's Pond Fishway

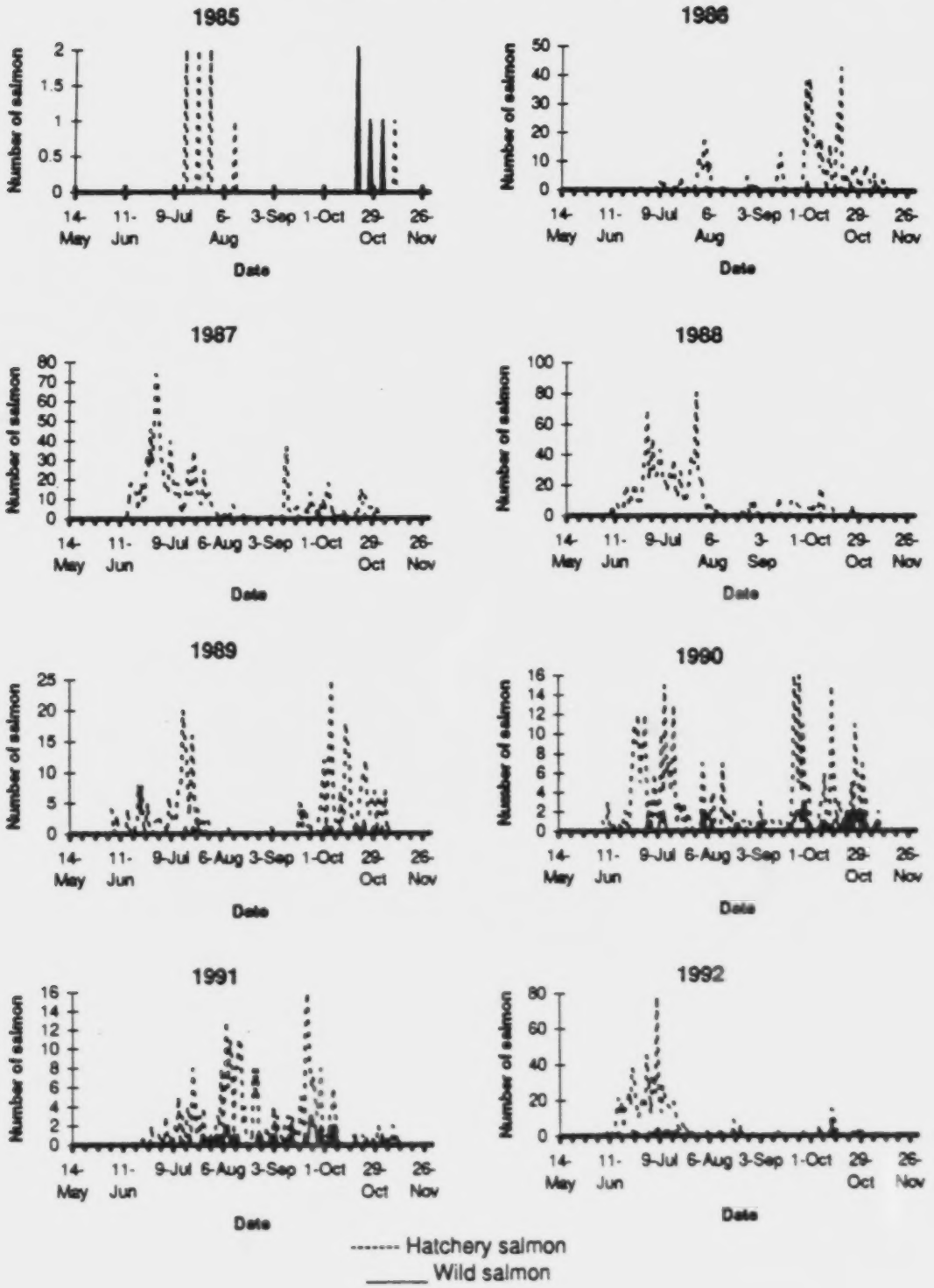
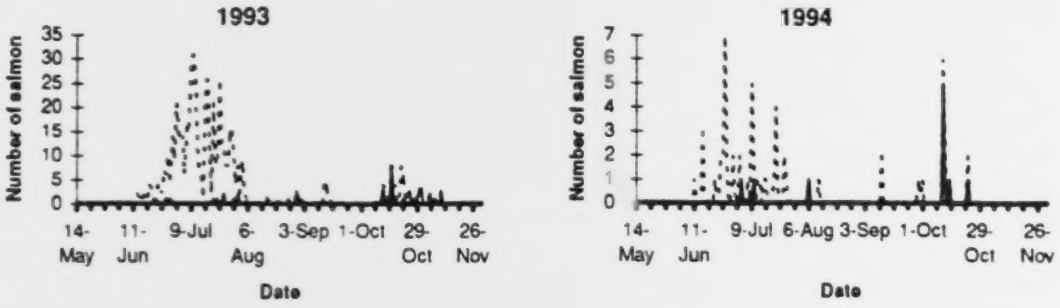


Fig. 6 (continued)

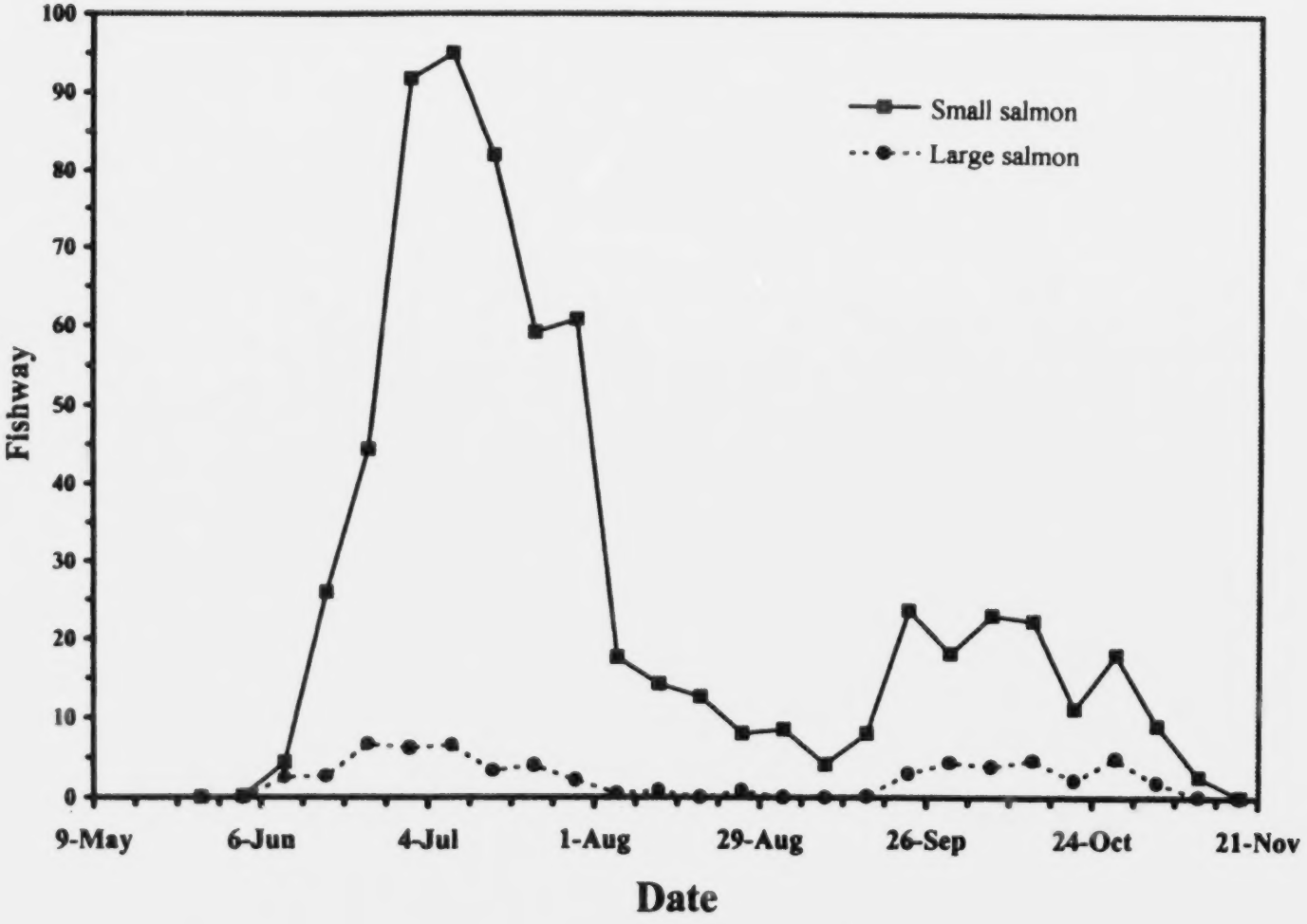
Run Timing Data for Morell River Salmon Based on Counts at Leard's Pond Fishway



------- Hatchery salmon
_____ Wild salmon

Fig. 7

Mean run time data for the Morell River - 1988-1993



Appendix 1

Locations of electrofishing sites on the Morell. These sites were surveyed in late summer 1984, 1985, 1994, and in December 1994. The locations given below refer to site boundaries used in 1994. Site boundaries in 1984 and 1985 approximately correspond to the 1994 boundaries. Endpoints of boundaries used in 1994 were marked with wooden stakes. Rocks used to anchor barrier nets were piled around these stakes.

Kenny's Hole

This site is located on the West Branch of the Morell at Kenny's Road, an unnumbered road that runs between the crook in Route 22 at St. Theresa and the Peakes Road (Route 320). The site is downstream (east) of the road. The upper boundary runs across the stream at the lower edge of a small rock barrier. The distance between the north end of the upper boundary and the south edge of the road culvert is 10.6 m. The lower boundary is 42.4 m downstream from the upper barrier, as measured along the mid-line of the stream.

Leard's Bridge

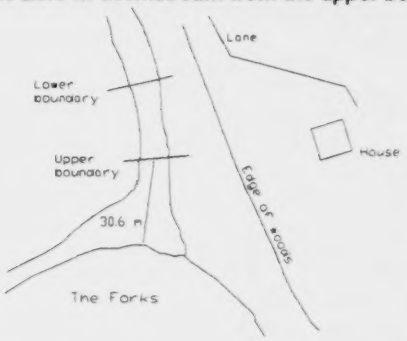
This site is located on the West Branch of the Morell at a washed-out bridge, just below Leard's Pond. Distances are measured from a concrete abutment on the east side which formerly supported the bridge. The upper boundary is 9.7 m upstream from the upstream edge of the concrete abutment. The downstream boundary is 10.0 m downstream from the downstream edge of the concrete abutment. The total length of the site is 30.2 m.

Crane's

This site is located where the East Branch crosses Rte. 355, the first road above the Forks between the East and West Branches. The site is upstream (south) of the bridge. The west end of the lower boundary is 4.9 m upstream from the timbered wall of the bridge on the west side. The east end of the lower boundary is 2.3 m upstream from the timbered wall of the bridge on the east side. The upstream boundary is 5.2 m downstream from the sill of the old Crane's dam. Total length of the site is 41.1 m.

Forks

This site is located just downstream from the confluence of the East and West Branches. The upper boundary is located 30.6 m downstream from the upstream bank of the pool formed at the confluence of the streams (see diagram). The lower boundary is 25.5 m downstream from the upper boundary.

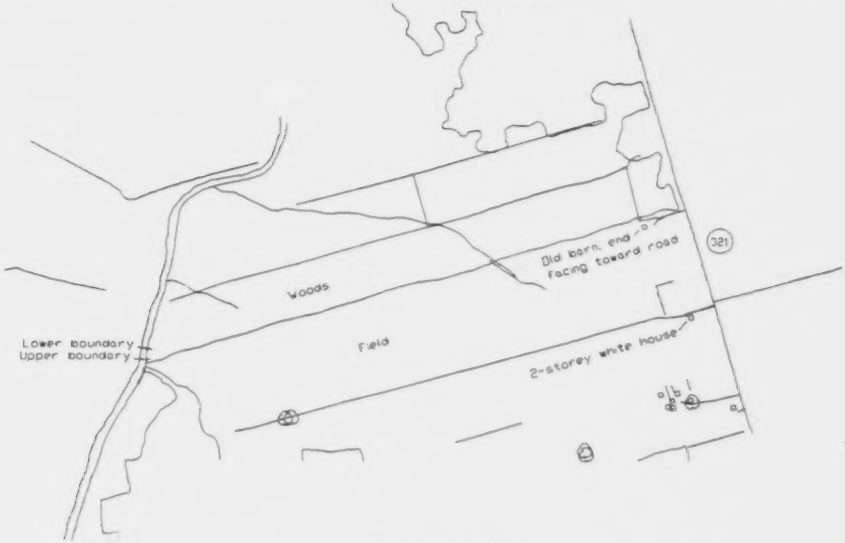


Mooney's Bridge

This site is located on the Main Branch just above Mooney's Road, an unnumbered seasonal road that runs west from the Bangor Road (Route 321). The site is located just south (upstream) from a washed-out bridge. In 1994, a stream deflector structure made of logs was installed on the east side of the river at the location of the old bridge pier. The lower barrier is located 11.2 m upstream from the point where this log structure meets the bank. The lower barrier is also located 19.2 m upstream from the point where this structure extends the greatest distance into the river. The upper barrier is 30.2 m upstream from the lower barrier.

Rowell's Riffle

This site is located on the Main Branch midway between Mooney's Bridge and Indian Bridge. The reference point for the upper boundary is an old barbed wire fence which follows the line between the field and woods, marked below, to the edge of the river. The old fence line meets the river at an old stump, which still has barbed wire attached. The upper boundary is 5.9 m downstream from this stump. The lower boundary is 21.3 m downstream from the upper boundary. Access permission was obtained from Donald Rowell, the landowner.



Rowell's Riffle